Northeastern Forest Experiment Station

Upper Darby, Pa.

BI-MONTHLY REPORT ON

FOREST INFLUENCES AND FLOOD CONTROL SURVEYS

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FOREST INFLUENCES

by H. C. Storey

EXAMINATION OF water problems of the Northeast indicates that the following general conditions prevail: The total amount of water available from surface and underground supplies is adequate for any foreseeable needs; the water is not distributed in time and space to meet the needs; in many places the quantity is adequate, but the quality renders the water unusable without considerable treatment.

Population increases--coupled with expansion of heavy industries--have resulted in ever-increasing demands for larger quantities of good water. Concentration of populations in metropolitan areas has resulted in the need for importing water from greater and greater distances.

New York City's water situation presents a striking example. Since the turn of the century, the population of this city has increased from 3-1/2 million to more than 8 million. During this period water consumption has increased from 390 million gallons per day to about 1150 million gallons per day. To keep pace with this mounting demand, after extensive developments in Croton watershed (25 to 50 miles north of the city), it was necessary to go to the Catskill Mountains for increased supplies. This meant reaching out some 100 miles for water. As it became evident that still more water would be needed, the City turned to the headwaters of the Delaware River. Plans to divert water from two tributaries of the Delaware River were held up by litigation, then by the war, so that this development will not be completed until 1956.

During the past year a drought resulted in reduced streamflow, and as a consequence heavy drafts were made upon storage reservoirs in the New York system. By late fall of 1949, reservoir storage was down to one-third of capacity. This was an alarming situation. If trends had

continued much longer, the largest city in the United States would have been faced with a water famine.

Recent precipitation has reversed the trend and reservoir levels are a little higher, but the situation will still be critical until water from the Delaware is available. Even then New York will not be out of trouble. Engineers estimate that by 1970 the consumption will again overtake the supply, and new supplies should be developed before that time. New York is now making plans to build more dams and diversions designed to remove more water from the Delaware.

As New York City, northern New Jersey, the Philadelphia-Camden area, and many other cities and towns look to the Delaware and its tributaries for future water supplies, it has become evident that an integrated plan for water development is needed for the basin. Such a plan should determine the amount of water needed over an extended period (probably to the year 2000), the amount of water available, and what measures should be taken to develop the needed supplies. All uses of water should be considered for the entire basin.

Such a plan is being developed by the Interstate Commission on the Delaware River Basin. This activity is being financed by the states of New York, New Jersey, and Pennsylvania.

A preliminary report has been released by Incodel. This report indicates that the total quantity of water available is adequate for all anticipated needs, but better regulation of streamflow is necessary. The report states that: "Half of its water crops rushes to the sea in only thirty percent of the time, leaving less than normal water flow in the river for seventy percent of the time." The report recommends as the first phase of development a system of dams for storing flood flows. Such stored water would then be available for, first, maintaining higher flows during dry weather periods and, second, diversion to areas needing additional supplies. It is estimated that this first phase of the water-development plan would cost between 500 and 600 million dollars.

In the development of these preliminary plans no consideration has been given to watershed condition nor to the possibilities of improving water flow characteristics by watershed-management methods. This is necessary to a certain extent, because some steps must be taken as soon as possible to obtain increased water supplies for the New York - Northern New Jersey areas. In the long run, consideration of water development in the basin should definitely include studies of watershed conditions. Studies should be made to determine the magnitude of the effect that watershed-management practices may have upon streamflow regulation. In addition, the amount of reduction in the rate of siltation in the proposed reservoirs that may be accomplished by changes or modification of land-use practices should be determined. If an appreciable part of the streamflow regulation job can be accomplished by measures in the watershed, the proposed structures may be used more efficiently for water diversion, and future proposed structures may be smaller and less costly than would be needed with no changes in watershed conditions. Reduction in siltation rates will increase the useful life of the proposed structures.

The Station is now analyzing precipitation and streamflow records for certain tributaries of the Delaware to determine maximum and minimum streamflow rates as affected by differences in land use.

THE NEW YORK CITY WATER PROBLEM

As an essential phase of the above, but in connection with a special problem on its own, the Station has had several joint conferences with the New York Water Commission folks and the Soil Conservation Service about special surveys of the New York reservoirs and watersheds. Accordingly, plans have been made to conduct a 3-way cooperative siltation survey of Schoharie Reservoir, which is part of the New York system. Schoharie watershed lies to the east of the East and West Branches of the Delaware and flows north into the Mohawk River. A preliminary examination of this reservoir indicates that a large amount of siltation has occurred during the 24 years that the reservoir has been in existence. Geology, soils, and land use in the Schoharie watershed appear to be similar to conditions in the upper part of the two branches of the Delaware. A land-use and erosion survey of Schoharie watershed will also be made by the Station to determine where the sediment is coming from and what land-use practices seemingly contribute to excessive erosion.

Data on soil, slope, and erosion will be furnished by the Soil Conservation Service to aid the Station in its field survey. Figures from these surveys will also be used to estimate the probable magnitude of the erosion problem in the headwaters of the Delaware.

DELAWARE BASIN RESEARCH CENTER

by H. C. Storey

Delaware-Lehigh Experimental Forest

The end of March marks the end of another unusually open winter in the Poconos. Measurements at the Dilldown watershed have now been carried through two winters. Precipitation at Dilldown from the first of October through February totalled 17.89 inches as compared with 19.62 inches for the same months in 1948-49. Most of the precipitation during the past winter was in the form of rain until the middle of February. From the 13th of February until the end of the month 2.94 inches of precipitation was recorded, mostly in the form of snow and sleet. At the end of February snow accumulation on Dilldown averaged 9.6 inches in depth and contained 2.48 inches of water.

There was no frost in the soil prior to the snowfall, and although air temperatures dropped to slightly below zero on several occasions during the latter part of February, no frost formed. This was undoubtedly due to the effectiveness of the snow cover in reducing radiation. During this period temperatures in the humus layer dropped to about 30 degrees while the upper mineral soil layer reached 32 degrees.

During March the snow gradually melted so that by the middle of the month most of the snow was gone. Another cold spell with air temperatures dipping to -10 degrees produced concrete frost in the humus layer at all points sampled in the scrub oak area. On the 21st about 10 to 12 inches of snow fell. A series of frost observations on the 23rd in areas near Dilldown showed scattered patches of concrete frost in scrub oak areas, no frost in nearby hardwood forest areas nor in stands of mixed white pine and hardwoods. Snow depth on the spots sampled in each of the areas ranged from 6 to 8 inches. So far, it appears that, given a "normal" winter with long periods of low temperatures, we can expect more concrete frost development in scrub oak areas than under good forest conditions.

Streamflow at Dilldown for the period October 1 to the end of February totalled 8.15 inches. This is nearly 2½ inches less than for the same months last year. The difference is due to the difference in precipitation and the fact that 2.48 inches of precipitation was still stored in the form of snow at the end of February. The highest peak flow so far this season was 64 c.f.s. on March 8. This represents about 25 c.s.m. Last season the peak flow was 80 c.f.s., recorded on May 7; this equals 32 c.s.m.

Measurements of ground-water elevations were started in Dilldown watershed about the middle of December, 1948. The first significant rise in ground-water elevation occurred during the last few days of December, 1948 and the first week of January, 1949. From this time until the end of May, 1949, the water table fluctuated moderately, ending up at about the same elevation towards the end of May that it had near the first of January. From the end of May until September 28 the

water table shows a steady drop--even though some 15 inches of rain fell during this period. September 28, 1949 marks the occurrence of the minimum ground-water elevations. From this minimum point, ground-water elevations rose steadily until the end of December. During January and February, 1950, the water level has remained more or less constant. As of the end of February the water level was from 3 to 4 feet lower than a year ago. During the period of record the ground-water table has shown a fluctuation of about 20 feet between the maximum and minimum elevations. This supports our ideas as to the comparatively low storage capacity of the underlying rocks. Water is occurring along cracks and crevices in the well-cemented sandstone. If water were being carried within the rock body there would be much less fluctuation of the water table.

Pocono Experimental Forest

Precipitation on the Pocono Experimental Forest totalled 14.77 inches for the period October 1 to February 28. This was about 3 inches less than Dilldown received for the same period. More of the precipitation on the Pocono was in the form of snow than at Dilldown. For example, on March 14, Dilldown had $5\frac{1}{2}$ inches of snow with a water content of 1.6 inches; on March 16 the Pocono had $11\frac{1}{2}$ inches of snow with a water content of slightly over 3.5 inches. No precipitation occurred between the two series of readings. The Pocono Forest probably averages 100-150 feet higher elevation than Dilldown.

No frost has been observed below the litter on the Pocono Forest. Some granular ice has been observed on the litter before the snow cover developed.

Development of a rating curve for the streamgaging station on the Pocono is still in progress; therefore, streamflow totals have not been computed. The peak flow so far recorded for the current hydrologic year was approximately 16 c.f.s., occurring on March 8. This represents about 18 c.s.m.

Delaware Basin, general

On March 23, following a rather heavy rain during the night of 22-23, a number of observations of turbidity were made at various points on the Lehigh River and some of its tributaries. The following tabulation presents the information:

Point of Measurement	Area (Sq. Mi.)	Turbidity (p.p.m.)
Dilldown Creek at streamgaging station	2.54	0
Lehigh River at Stoddartsville	92.	0
Lehigh River at Tannery	322.	0
Lehigh River at Allentown above entrance of Little Lehigh	1,000.	150
Little Lehigh 75 yds. above entrance into Lehigh	180.	600
Monocacy Creek above entrance into Lehigh	50.	600
Lehigh River below entrance of Monocacy Creek near New Street Bridge, Bethlehem	1,280.	200

These measurements were made along the banks of the stream, therefore do not represent an average measurement throughout the cross section, but they give a good picture of the relative condition. The Lehigh watershed above both Tannery and Stoddartsville is predominantly forested. Between Tannery and Allentown a number of tributaries that enter the Lehigh drain agricultural lands. The Little Lehigh and Monocacy Creek watersheds are largely agricultural.

This general condition was observed a number of times during the summer of 1949. Following a heavy rain, the Lehigh would be flowing quite clear at Tannery, only slightly turbid at Allentown, and very turbid at Bethlehem. It appears that the largest part of the sediment load that the Lehigh discharges into the Delaware River is originating on rolling agricultural land south of Lehighton. This represents about the lower half of the watershed.

Detailed plans have been drawn up for a land use-erosion survey of Schoharie watershed in New York State. This watershed lies just east of the headwaters of the East and West Branches of the Delaware. In addition, a siltation survey will be made on the New York City reservoir in this watershed. Figures obtained from these surveys will be used as guides in determining the probable erosion problem in the headwaters of the Delaware. These surveys will be started as soon as weather conditions permit.

Other activities

Gen Shimizu, a forester from Japan, spent two days going over our research program. He was interested in methods of study and instrumentation.

Ned Bethlahmy is attending the winter session of the statistical course at the Washington office. After that episode, he should be quite happy to get back and spend some peaceful hours digging soil sample pits.

Reigner and Storey attended the I & E training session held at Warren, Pa. This was a well-run meeting and certainly worth the time and effort put into it.

Leon Lassen spent several days in January going over our activities and plans. We were able to show him muddy surface runoff from frozen pastures in the Lackawaxen River watershed (tributary to the Delaware) as contrasted to no surface runoff from adjacent unfrozen wooded areas. Although such a demonstration is quite interesting, we cannot guarantee it for every visitor.

Reigner and Storey gave talks to a PTA group and a meeting of fire wardens. These talks covered forest and water problems of the area and research work now being carried on to solve these problems.

MOUNTAIN STATE RESEARCH CENTER

by Sidney Weitzman

General

The recently activated Mountain State Research Center of the Northeastern Station is the scene of research in both timber management and watershed management. Because of limited funds and personnel, the first year was devoted primarily to getting a sound timber-management program under way. Much of this has been accomplished.

Efforts are now directed toward an equally sound watershed-management program. The Fernow Experimental Forest at Parsons, West Virginia, was selected as the field laboratory for the conduct of both timber-management and watershed-management research. The watershed-management efforts to date include the following:

1. Survey of the area.
2. Delineation of watersheds.
3. Soil survey.
4. Determination of cover types.
5. Selection of watersheds which lend themselves to influences research.
6. Preparation of a working plan.

A meeting with the Director and his staff is planned for April on the Fernow Experimental Forest. At this time a final decision will be made about the treatments to be studied on the Fernow Experimental Forest.

This Experimental Forest lends itself remarkably well to coordinating the efforts of both timber-management and watershed-management research. Timber-management practices have been laid out on a watershed basis because that is the natural logging unit in this mountainous area. In view of the great importance of timber and water in this area, it is desirable to determine the effect of timber-cutting practices on water quality and quantity as well as on tree growth. Since cutting practices go hand in hand with their effect on water as well as timber, it is essential to establish the relative merits of cutting practices on timber and water. Only after the relationship between water management and timber management have been determined can a sound land-use program be developed for this critical mountainous area with its abundant rainfall, shallow soils, and steep slopes.

It is necessary to determine the relative merits of each cutting practice in economic returns as well as water quality and quantity. This coordinated research program will tie together timber management and watershed management on a pilot-plant basis.

So much for the over-all plan of approach. After the working plan has been discussed in detail and improved, we will outline some of the more salient features of each cutting practice level that will be of interest to others.

Skid road erosion

A small study was begun to determine the effects of skid road lay-out and after-logging care on the amount of sediment moved. This study was planned in conjunction with the cutting-practice-level plots on the Fernow Experimental Forest. Stakes were installed along the skid roads on each of the four cutting-practice-level plots. Soil profile was determined prior to logging and after logging. Measurements will be taken at 6-month intervals to determine the amount of sediment moved in skid roads under each of the different logging methods used in each of the four cutting-practice-levels.

In the poor cutting-practice-level plot, skid roads are laid out without any regard to water values. They simulate commercial operations in which roads run straight up and down the hillsides.

In the fair cutting-practice-level, skid roads are laid out to remove the timber as cheaply as possible and without any regard to water values. These roads also run straight up and down hill. However, after logging, water diversions will be installed at regular intervals.

In the good cutting-practice-level, no skidding is permitted in stream beds or drainage channels. Main skid roads have been laid out not to exceed a 20 percent slope. Immediately after logging, all skid roads and trails were properly drained and water diversions established.

Under high-order cutting-practice-level, main skid roads did not exceed a 10 percent slope except for short intervals. The formation of new drainage or erosion channels through repeated use of a single approach in moving logs to the skid roads was avoided. Immediately after logging, all skid roads and trails were properly drained and diversions installed. The main skid road will be revegetated this spring.

FLOOD CONTROL SURVEYS

by Arthur Bevan

BACKGROUND

The Northeast experienced a moderately severe drought last year from April to November. Subnormal precipitation combined with above-normal temperatures resulted in deficient streamflow and low water tables. More severe droughts have occurred in the past. Record low flows were registered only at a few localities. Complete crop failures occurred in some areas and reduced yields in others. In Pennsylvania, New York, and New England many individuals and small communities experienced failure of well or other water supplies and had to extend their wells deeper. New York City suffered a critical water shortage.

Runoff and ground-water levels improved from December to March. Precipitation was about normal along the Atlantic Coast and about 50 percent above normal in the interior. Temperatures for the same period averaged about 4 to 6 degrees above normal. Snowfall was extremely light until February. Frequent snowfall brought the snow cover to near normal in northern New England and New York. Reservoir storage and ground-water levels are now generally near normal levels.

A severe ice storm occurred in north central Pennsylvania on February 16. Damage to trees was great and many miles of power and communication lines were down. Ice formation 2 inches thick was reported in this area.

Near the end of March warm rains accompanied by rapid snow melt in some localities resulted in minor flooding in Northern Pennsylvania and Southern New York. The Upper Susquehanna, Genesee, and Mohawk Rivers were reported above flood stage. Roads were flooded on many of the smaller tributaries. But, in general, damages were light.

Five flood control surveys for which the Forest Service has primary responsibility are in various stages of completion in the Northeastern Station territory. These surveys, in the order in which they were started, are in the Connecticut, Merrimack, Allegheny, Monongahela, and the Upper Susquehanna watersheds. We have also participated to date in four Soil Conservation Service surveys--in the Youghiogheny, Roanoke, Lehigh, and the Delaware watersheds. Work is now in progress to revise and complete the Connecticut, Merrimack, and Youghiogheny surveys in accordance with Departmental policies setforth in the Secretary's memorandum of September 29, 1949, as amended January 6, 1950.

CURRENT PROGRAMS

Considerable progress has been made in developing data on the accomplishment of going programs where they contribute to the objectives of flood control.

A series of meetings was held with the Extension Service and P.M.A. in the States of Vermont, New Hampshire, Massachusetts, Connecticut, and Maryland. Both agencies provided data on their current programs and on the necessary expansion of their programs to meet flood control objectives. The Soil Conservation Service supplied data on the establishment carried out by districts, and the Regional Forester provided similar data on Norris-Doxey farm foresters.

Tabulation and analysis of the data collected has brought out some interesting problems. There is a considerable overlap--P.M.A. reporting ACP payments on areas also reported by Soil Conservation Districts, Soil Conservation Districts reporting the same areas as the farm forester, etc. It appeared necessary to get a measure of this overlap in order to develop a reasonable picture of the accomplishment of current programs. Arrangements were made at the state level to have county representatives of the various agencies study the reported accomplishments for their counties and indicate where overlaps occurred. This procedure was carried out in Hartford County, Connecticut, and Windsor County, Vermont. Data from all agencies was tabulated in this office and forwarded to the county group for review. A meeting of the County Agent, P.M.A. County Committeeman, Farm Forester, and District Conservationist was held to review the figures and arrive at a reasonable estimate of the actual accomplishment in the county. The results were most illuminating and were a remarkable tribute to how closely these agencies work together at that level.

Expansion of data on going programs also presents a particular problem. To expand annual accomplishments for the period of installation of a flood control program for all measures is not realistic. To illustrate: cover crops to prevent erosion and improve infiltration may represent to a large extent the establishment of cover crops on the same acres year after year with little or no increase. These conferences have indicated some other problems bearing on the proposed flood control program. The cost of Extension Service participation appears to vary in direct relation to the number of states involved in the watershed rather than in any direct proportion to the size of the watershed. This problem has not yet been solved.

The extent to which P.M.A. should participate in the development to the program, particularly where it differs from Soil Conservation Service plans, has come up as a problem that will need to be solved. We would be particularly interested in learning of the experience of other Stations in similar situations.

Status of Surveys

Connecticut River.--Data on going programs have been collected and compiled. Other revisions are under way. We look for an early completion of this report.

Merrimack River.--Review of rough draft reviewed by Region 7 and Soil Conservation Service. Data on going programs collected.

Allegheny River.--This report was about 85 percent complete. Revisions and adjustments to meet present policies and procedures will require some additional work. Minor progress on this report in the past two months.

Monongahela River.--Damage appraisal completed. Report about 50 percent complete. No further work will be done on this survey until the three previous watersheds are complete.

Susquehanna River.--Field work completed and data compiled. No further work will be done on this watershed until the Monongahela is completed.

Preliminary examinations and advance studies

No activities.

Cooperation with Soil Conservation Service and other agencies

Youghiogheny River.--Participating in revision of report. Collection of data on going programs under way.

Delaware River.--Field work completed. Work being slowed up by revision of Youghiogheny report.

Lehigh River.--Report abandoned, being combined with Delaware River report.

Roanoke River.--No action.

Meetings

The annual meeting of the Lehigh Flood Control Council, held February 2, was attended by the Director and Bevan.

An organization meeting of the Small Streams Association in Washington, D. C., on March 24, was attended by Bevan.

The annual meeting of the New York State Soil Conservation District Directors at Utica, N. Y., on March 27 was attended by Bevan. He reported on progress of the Upper Susquehanna flood control survey. He also attended a meeting of the Flood Control Committee established by the Soil Conservation Districts in the Upper Susquehanna watershed. At the request of the chairman we participated in a meeting of the Committee on Flood Control, Irrigation, and Drainage.